Vortechs® Stormwater Treatment System
Field Testing Report

DeLorme Publishing Company
Yarmouth, Maine

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Introduction

This paper will report on the Vortechs® System Monitoring Program at the DeLorme Publishing Company in Yarmouth, Maine. It is an interim report as the project will continue for one year of which seven months have been completed, spanning 20 storms from May to November 1999. A two-month 'trial run' was conducted at the end of 1998, without the benefit of a flow meter. The monitoring program was designed to expand upon the information gathered in the 'trial run' by adding a flow meter to monitor flow through the Model 11000 Vortechs® System on the site, thereby making calculation of event mean concentrations (EMCs) possible for each storm and for the period. The data contained in this report is the most current and most significant part of CONTECH' ongoing field data collection program.

Description of the Study

Prior to this study, CONTECH developed an extensive body of laboratory data to document total suspended solids (TSS) removal efficiency. This data provided a basis for the optimal sizing of Vortechs® Systems to achieve sufficient removal of TSS to meet the current prevailing standards of performance. One purpose of this study was to confirm that performance predicted in the laboratory would, in fact, be accomplished by a correctly sized system in the field.

A secondary purpose of the study was to subject CONTECH rigorous laboratory and field testing to third party review. The Vortechs® System has been approved for use by a diverse array of regulatory agencies on hundreds of projects from coast to coast, but there has not been, to date, a third party review of CONTECH field testing data to re-confirm that the goals of those agencies are consistently met by the Vortechs® System.

The 1999 study has proceeded in accordance with a protocol that was the result of a collaborative effort and includes several unique features as well as some features common to other protocols from similar testing programs. Salient items include:

- the use of automatic Isco model 6700 samplers and one Isco model 4250 flow meter with a low profile area-velocity sensor and one Isco 674 rain gauge
- automatic samplers were deployed to take flow weighted composite samples directly from the inlet and the outlet of the treatment system[1]
- comparison of samples obtained automatically with those obtained manually to confirm that the automatic samplers are pulling representative samples (see Figure 1 in the Project Narrative)
- the use of event mean concentrations (EMCs) of the influent and effluent through the treatment system to calculate operating efficiency in each storm
- the use of a flow-weighted average of EMC's over the period of study to calculate the influent TSS and effluent TSS as a 'period mean concentration' (PMC) and the overall operating efficiency for the period

[1] Deployment in these locations would change if the system was installed with a bypass structure to divert high peak flows. In such cases the sampling points would be upstream of the bypass and downstream of the junction of treated and untreated flows. This is referred to as testing the entire treatment system (including bypassed flows) as opposed to testing the treatment facility (excluding bypassed flow). Where there is no bypass they are one and the same.

- since prevailing standards generally are intended to require some stated level of performance on “an average annual basis”, the number of storms to be monitored will be the number of storms sampled over a one-year period.
- Samples were handled and analyzed for TSS concentration according to Standard Method 2540 D

Description of the Site

The study site is the headquarters of DeLorme Publishing, Inc in Yarmouth, Maine. The building, driveway, parking lot and ancillary facilities were constructed, with all necessary permits, in 1996. DeLorme is best known as a publisher of maps and the building houses a retail map store and the world’s largest (42-foot diameter) rotating globe as well as its production facilities. The map store and globe draw a large number of tourists and it is not unusual for the 300-space, 4-acre parking lot to be filled to capacity with passenger cars and tour busses. Besides this parking lot, DeLorme owns some landscaped area that is tributary to the stormwater treatment system and there also exists a culvert that drains an off-site highway access ramp. The total of these unpaved tributary areas is estimated at about 3 acres; the (Rational Method) runoff coefficient associated with the same area is estimated to be about 0.40.

Project Narrative

In December of 1998, following the 2-month trial run, the automatic samplers were removed at the request of DeLorme to accommodate Winter snow removal operations. The samplers were re-installed in May of 1999. Just before the samplers were re-installed, the entire parking lot had been swept. Presumably the sweeping operation removed a large amount of sediment that might otherwise have been trapped by the Vortechs® System. As it was, the first rainfall event that was sampled exhibited a very low influent event mean TSS concentration of 65.9 milligrams per liter (mg/l). Not surprisingly the removal efficiency calculated for that event was very low.

Another issue impacting the study in its early stages was the extraordinarily dry weather that lasted all summer. However, the long “antecedent dry periods” produced high influent concentrations, in some cases, which did provide opportunities to evaluate performance during periods of critical need for treatment.

As called for by the protocol, several checks were performed on the “representativeness” of the samples collected by the automatic samplers. This was done by carefully grabbing a manual sample from the flow stream and then comparing it to the automatic sample that was taken simultaneously by the Isco sampler. These checks exhibited correlation's between the manual and automatic samples that were fair to good at the outset and which have been steadily improved upon. The strainer deployment at the influent end revealed somewhat less consistent correlation and was modified as the study progressed. Figure 1 is a plot of the very good correlation between the manual and automatic samplers that was obtained from the deployment configuration that was ultimately found to be the best. This configuration is to suspend the perforated strainer at the end of the suction tube from the sampler; the point where it is suspended is directly “in front of” (that is downstream of) the inlet pipe invert. It is noteworthy that, in the calibration shown, the net difference between the concentrations measured by the automatic and manual samples was just 1.3%.

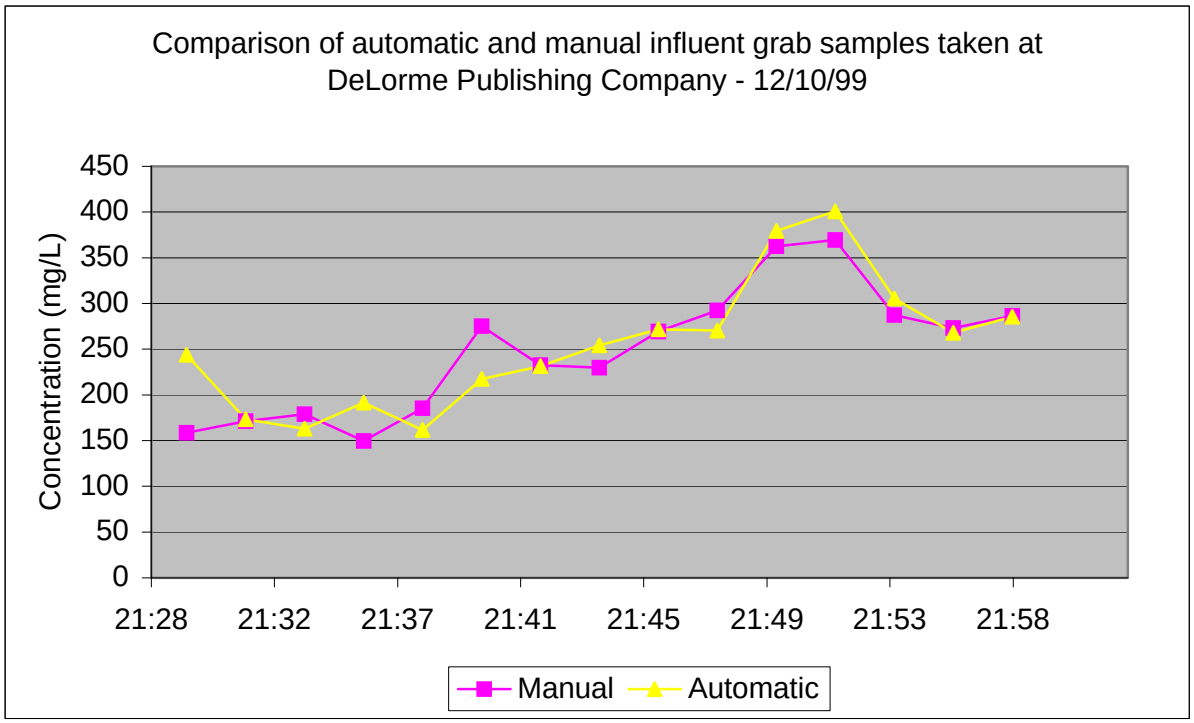

Figure 1

The flowmeter was calibrated in the laboratory before deployment and gave lower than expected readings for the first 10 storms. To correct this problem, it was removed from the site, reprogrammed, recalibrated and reinstalled. After this adjustment it gave more accurate flow measurements. EMCs for all the storms tested when the flow meter was not working properly were unaffected by this adjustment. However, the amount of flow treated during all those storms was increased uniformly to compensate for the under reporting error so that the final overall efficiency could be calculated.

Results

The net removal efficiency for the 20-storm, 7-month period was approximately 80 %. See Table 1 for details. Peak rainfall intensities for the period ranged from .01"/hr up to .52"/hr.

Conclusion

The Vortechs® System on this site is designed to remove 80% of the net annual TSS load for an average year based on local rainfall intensity distribution data, site size and laboratory tests that document the removal efficiency of silica based solids over a range of operating rates.[2] Stormwater360 generally uses the removal efficiency of 50 micron sediment in the laboratory as a basis for predicting system performance in the field. The fact that the system achieved an observed removal efficiency so close to the goal is evidence that the sizing methodology is a reasonably accurate way to predict field performance.

[2] See Technical Bulletins 1-4 in CONTECH' Technical Design Manual for additional information on laboratory testing, sizing and design criteria.

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Summary Statistics

Storm #	Storm Date	Total Precip. (in)	Subsamples # Taken	Influent EMC (mg/L)	Effluent EMC (mg/L)	Runoff Sampled (ft^3)	Influent EMC x Sampled Volume (mg)	Effluent EMC x Sampled Volume (mg)
1	5/24/1999	0.30	28	65.9	50.3	21000	1384432	1055514
2	6/24/1999	0.52	17	1010.7	149.2	6375	6443467	950925
3	6/28/1999	0.32	12	1364.9	63.6	4500	6142012	286282
4	7/6/1999	0.32	13	857.6	49.4	9750	8361551	481290
5	7/18/1999	0.53	11	367.6	145.9	8250	3033088	1203980
6	7/24/1999	0.46	18	533.2	57.8	6750	3599066	389818
7	8/7/1999	0.55	30	43	31	11250	483750	348750
8	8/14/1999	0.75	40	1088.8	52.0	15000	16331909	779528
9	8/29/1999	0.1	6	37.2	33.6	2250	83591	75503
10	9/7/1999	0.17	12	61.0	38.0	4500	274500	171000
11	9/15/1999	5.45	123	88.8	59.1	15600	1385238	922672
12	9/30/1999	0.48	40	111.6	47.3	4000	446465	189024
13	10/4/1999	0.53	70	46.2	19.8	7000	323108	138453
14	10/9/1999	0.13	12	69.2	14.7	2400	166178	35294
15	10/14/1999	0.43	40	33.1	12.6	8000	265010	100435
16	10/23/1999	1.91	40	164.1	93.2	8000	1313022	745550
17	11/2/1999	1.02	80	233.6	102.4	16000	3737052	1638485
18	11/11/1999	0.27	33	93.3	25.5	6600	615609	168445
19	11/14/1999	0.25	32	57.4	21.0	6400	367624	134293
20	11/20/1999	0.30	37	188.4	70.3	7400	1394504	520000
					Column Sum --->	171025	56151176	10335241

Net Period Removal Efficiency: 81.59%
Net Influent Period Mean Concentration (PMC): 328.3
Net Effluent Period Mean Concentration (PMC): 60.4

Table 1